

What is claimed is:

1. In a speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, a method of analyzing the input speech signal comprising:

generating from the target vector and the short term characteristics, a plurality of sequences of variable-amplitude pulses, each of the sequences having a different average amplitude value; and

outputting a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

2. A system according to claim 1, wherein the target vector is matched using a perceptual weighting criterion.

3. A speech processing system including a signal processor arrangement that analyzes an input speech signal and, in response, generates the short-term characteristics of the input speech signal and a target vector, comprising:

means for generating from the target vector and the short term characteristics, a plurality of sequences of variable-amplitude pulses, each of the sequences having a different average amplitude value; and

means for outputting a signal corresponding to a sequence of equal-amplitude pulses which, according to an error criterion, represents the target vector.

4. A system according to claim 3, wherein the target vector is matched using a perceptual weighting criterion.

1 5. A speech processing system including a signal processor arrangement that analyzes an
2 input speech signal and, in response, generates the short-term characteristics of the input speech
3 signal and a target vector, comprising:

4 an analyzer adapted to receive the target vector and the short term characteristics and to
5 generate a plurality of sequences of variable-amplitude pulses, each of said sequences having a
6 different average amplitude value;

7 the analyzer being further adapted to output a signal corresponding to a sequence of
8 equal-amplitude pulses which, according to an error criterion, represents the target vector.

1 6. A system according to claim 5, wherein the target vector is matched using a perceptual
2 weighting criterion.

3 7. A speech processing system including a signal processor arrangement that analyzes an
4 input speech signal and, in response, generates the short-term characteristics of the input speech
5 signal and a target vector, comprising:

6 a multi-pulse analyzer adapted to receive the target vector and the short term
7 characteristics and to generate a plurality of sequences of variable-amplitude, variable-sign and
8 variably-spaced pulses, each of said sequences having a different average amplitude value, each
9 of said pulses within each sequence having variable amplitudes and variable signs;

10 the multi-pulse analyzer being further adapted to output a signal corresponding to a
sequence of equal-amplitude, variable-sign, variably-spaced pulses which, according to a
maximum likelihood criterion, most closely represents the target vector.

1 8. A system according to claim 7, wherein the target vector is matched using a perceptual
2 weighting criterion.

1 9. A system according to claim 7, wherein the pulse amplitude variations are based on at
2 least one of: the exponential function; a linear function; the short-term characteristics of the

3 input speech signal; the long-term characteristics of the input speech signal; and the excitation
4 signal from previous frames.

1 10. A speech processing system comprising:
2 a short-term analyzer that analyzes an input speech signal, and in response to said input
3 speech signal, generates the short-term characteristics of the input speech signal;
4 a target vector generator for generating data including a target vector from at least said
5 input speech signal, and optionally, said short-term characteristics; and
6 a multi-pulse analyzer adapted to receive the target vector and the short term
7 characteristics and to generate a plurality of sequences of variable amplitude, variable sign,
8 variably-spaced pulses, each of said sequences having a different average amplitude value, each
9 of said pulses within each sequence having variable amplitudes and variable signs, said multi-
10 pulse analyzer for outputting a signal corresponding to the sequence of equal amplitude, variable
11 sign, variably spaced pulses which, according to a maximum likelihood criterion, most closely
12 represents said target vector.

1 11. A system according to claim 10, wherein the target vector is matched using a perceptual
2 weighting criterion; and
3 wherein the pulse amplitude variations are based on at least one of: the exponential
4 function; a linear function; the short-term characteristics of the input speech signal; the long-term
5 characteristics of the input speech signal; and the excitation signal from previous frames.

1 12. A speech processing system comprising:
2 a short-term analyzer that analyzes an input speech signal, and in response to said input
3 speech signal, generates the short-term characteristics of the input speech signal;
4 a target vector generator for generating a target vector from at least said input speech
5 signal, and optionally, said short-term characteristics; and

6 a multi-pulse analyzer connected to an output line of said target vector generator and an
7 output line of said short term analyzer, wherein said multi-pulse analyzer generates a plurality of
8 sequences of variable amplitude, variable sign, variably spaced pulses, each of said sequences
9 having a different average amplitude value, each of said pulses within each sequence having
10 variable amplitudes and variable signs, said multi-pulse analyzer for outputting a signal
11 corresponding to the sequence of variable amplitude, variable sign, variably spaced pulses which,
12 according to the maximum likelihood criterion, most closely represents said target vector.

1 13. A system according to claim 12, wherein the target vector is matched using a perceptual
2 weighting criterion.

14. A system according to claim 13, wherein the pulse amplitude variations are based on at
least one of: the exponential function; a linear function; the short-term characteristics of the
input speech signal; the long-term characteristics of the input speech signal; and the excitation
signal from previous frames.

15. A speech processing system comprising:

a short-term analyzer that analyzes an input speech signal, and in response to said input
speech signal, generates the short-term characteristics of the input speech signal;

a target vector generator for generating a target vector from at least said input speech
signal, and optionally, said short-term characteristics; and

a multi-pulse analyzer connected to an output line of said target vector generator and an
output line of said short term analyzer, wherein said multi-pulse analyzer generates a plurality of
sequences of variable amplitude, variable sign, variably spaced pulses, each of said sequences
having a different average amplitude value, each of said pulses within each sequence having
variable amplitudes and variable signs, said multi-pulse analyzer for outputting a signal
corresponding to the sequence of variable amplitude, variable sign, variably spaced pulses which,
according to the maximum likelihood criterion, most closely represents said target vector, and

13 one or more pulse sequence modifiers, each having as input at least a sequence of equal
14 amplitude, variable sign, variably spaced pulses, wherein each said pulse sequence modifier
15 modifies its input sequence and produces as output a sequence of variable amplitude, variable
16 sign, variably spaced pulses.

1 16. A system according to claim 15 wherein the pulse sequence modification function is
2 based on at least one of: the exponential function; a linear function; the short-term
3 characteristics of the input speech signal; the long-term characteristics of the input speech signal;
4 and the excitation signal from previous frames.

1 17. A speech processing system comprising:
2 a short-term analyzer that analyzes an input speech signal, and in response to said input
3 speech signal, generates the short-term characteristics of the input speech signal;
4 a long-term analyzer that analyzes an input speech signal, and in response to said input
5 speech signal, generates the long-term characteristics of the input speech signal;
6 a target vector generator for generating a target vector from at least said input speech
7 signal, and optionally, said short-term characteristics, and optionally, said long-term
8 characteristics; and
9 a pulse-train sequence analyzer connected to at least an output line of said target vector
10 generator and an output line of said short term analyzer, wherein said pulse-train sequence
11 analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced
12 pulse trains, each of said sequences having a different average amplitude value, each of said
13 pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train
14 sequence analyzer for outputting a signal corresponding to the sequence of equal amplitude,
15 variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion,
16 most closely represents said target vector.

1 18. A system according to claim 17, wherein the pulse amplitude variations are based on at
2 least one of: the exponential function; a linear function; the short-term characteristics of the
3 input speech signal; the long-term characteristics of the input speech signal; and the excitation
4 signal from previous frames.

1 19. A system according to claim 18, wherein the target vector is matched using a perceptual
2 weighting criterion.

1 20. A speech processing system comprising:
2 a short-term analyzer that analyzes an input speech signal, and in response to said input
3 speech signal, generates the short-term characteristics of the input speech signal;
4 a long-term analyzer that analyzes an input speech signal, and in response to said input
5 speech signal, generates the long-term characteristics of the input speech signal;
6 a target vector generator for generating a target vector from at least said input speech
7 signal, and optionally, said short-term characteristics, and optionally, said long-term
8 characteristics; and
9 a pulse-train sequence analyzer connected to at least an output line of said target vector
10 generator and an output line of said short term analyzer, wherein said pulse-train sequence
11 analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced
12 pulse trains, each of said sequences having a different average amplitude value, each of said
13 pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train
14 sequence analyzer for outputting a signal corresponding to the sequence of variable amplitude,
15 variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion,
16 most closely represents said target vector.

1 21. A system according to claim 20, wherein the target vector is matched using a perceptual
2 weighting criterion.

22. A system according to claim 20, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

23. A system according to claim 21, wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; the short-term characteristics of the input speech signal; the long-term characteristics of the input speech signal; and the excitation signal from previous frames.

24. A system according to claim 21 wherein the pulse amplitude variations are based on at least one of: the exponential function; a linear function; and characteristics of the input speech signal.

25. A speech processing system comprising:

- a short-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the short-term characteristics of the input speech signal;
- a long-term analyzer that analyzes an input speech signal, and in response to said input speech signal, generates the long-term characteristics of the input speech signal;
- a target vector generator for generating a target vector from at least said input speech signal, and optionally, said short-term characteristics, and optionally, said long-term characteristics; and
- a pulse-train sequence analyzer connected to at least an output line of said target vector generator and an output line of said short term analyzer, wherein said pulse-train sequence analyzer generates a plurality of sequences of variable amplitude, variable sign, variably spaced pulse trains, each of said sequences having a different average amplitude value, each of said pulse trains within each sequence having variable amplitudes and variable signs, said pulse-train sequence analyzer for outputting a signal corresponding to the sequence of variable amplitude,

15 variable sign, variably spaced pulse trains which, according to the maximum likelihood criterion,
16 most closely represents said target vector, and
17 one or more pulse-train sequence modifiers, each having as input at least a sequence of
18 equal amplitude, variable sign, variably spaced pulse trains, wherein each said pulse sequence
19 modifier modifies its input sequence and produces as output a sequence of variable amplitude,
20 variable sign, variably spaced pulse trains.

1 26. A system according to claim 25, wherein the target vector is matched using a perceptual
2 weighting criterion.

1 27. A system according to claim 25, wherein the pulse amplitude variations are based on at
2 least one of: the exponential function; a linear function; the short-term characteristics of the
3 input speech signal; the long-term characteristics of the input speech signal; and the excitation
4 signal from previous frames.

1 28. A system according to claim 25, wherein the pulse-train sequence modification function
2 is based on the exponential function.

1 29. A system according to claim 25, wherein the pulse-train sequence modification function
2 is based on a linear function.

1 30. A system according to claim 25, wherein the pulse-train sequence modification function
2 is based on the short-term characteristics of the input speech signal.

1 31. A system according to claim 25, wherein the pulse-train sequence modification is based
2 on the long-term characteristics of the input speech signal.

- 1 32. A system according to claim 25, wherein the pulse-train sequence modification function
- 2 is based on the excitation signal from previous frames.